Nike Site #92
Preliminary Assessment/Site Inspection
Kingston, Washington
TDD: 02-05-0011

Contract: 68-S0-01-01
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Region 10

START-2

Superfund Technical Assessment and Response Team

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NIKE SITE #92
PRELIMINARY ASSESSMENT/SITE INSPECTION REPORT
KINGSTON, WASHINGTON

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LIST OF ACRONYMS

Acronym	Definition
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
CRDL	Contract Required Detection Limit
DoD	Department of Defense
DQOs	data quality objectives
E & E	Ecology and Environment, Inc.
EPA	United States Environmental Protection Agency
FID	flame ionization detector
GPS	Global Positioning System
IDW	investigation-derived waste
MCL	Maximum Contaminant Level
µg/kg	micrograms per kilogram
MS/DUP	matrix spike/duplicate
NKSD	North Kitsap School District
NSDWR	National Secondary Drinking Water Regulation
PA	preliminary assessment
PID	photoionization detector
POL	Petroleum, Oil, and Lubricant
PPE	probable point of entry
ppm	parts per million
PRG	Preliminary Remedial Goals
QA	quality assurance
QC	quality control
%R	percent recovery
RPD	relative percent difference
SI	site inspection
SQAP	sampling and quality assurance plan
SQL	sample quantitation limit
START	Superfund Technical Assessment and Response Team

LIST OF ACRONYMS (CONTINUED)

Acronym	Definition
SVOCs	semivolatile organic compounds
TAL	Target Analyte List
TDL	target distance limit
TM	Task Monitor
UDMH	unsymmetrical dimethylhydrazine
USACE	United State Army Corps of Engineers
VOCs	volatile organic compounds

NIKE SITE #92
PRELIMINARY ASSESSMENT/SITE INSPECTION
KINGSTON, WASHINGTON

1. INTRODUCTION

The United States Environmental Protection Agency (EPA) has tasked Ecology and Environment, Inc. (E & E) to provide technical support and conduct a preliminary assessment/site inspection (PA/SI) at the Nike Site #92 located in Kingston, Washington. E & E completed the PA/SI activities under Technical Direction Document Number 02-05-0011 issued under EPA, Region 10, Superfund Technical Assessment and Response Team (START)-2 Contract Number 68-S0-01-01. The specific goals for this PA/SI were intended to address site assessment objectives and are presented below:

- Collect and analyze samples to characterize the potential sources discussed in subsection 2.6;
- Determine off-site migration of contaminants;
- Provide the EPA with adequate information to determine whether the site is eligible for placement on the National Priorities List; and
- Document any threat or potential threat to public health or the environment posed by the site.

Completion of this PA/SI included reviewing site information, determining regional characteristics, collecting receptor information within the site's range of influence, executing a sampling plan, and producing this report.

This document includes site background information (Section 2), field sampling activities and analytical protocols (Section 3), quality assurance/quality control (QA/QC) criteria (Section 4), analytical results reporting and background sampling (Section 5), potential sources (Section 6), migration/exposure pathways and targets (Section 7), summary and conclusions (Section 8), and references (Section 9).

2. SITE BACKGROUND

This section describes the site location (subsection 2.1), site description (subsection 2.2), site ownership history (subsection 2.3), site operations and waste characteristics (subsection 2.4), site characterization (subsection 2.5), and summary of investigation locations (subsection 2.6).

2.1 SITE LOCATION

Site Name:	Nike Site #92
CERCLIS ID Number:	WAN001002492
Location:	Kingston, Washington
Latitude:	47°47'47" North
Longitude:	122°30'59" West
Legal Description:	Section 26, Township 27 North, Range 2 East
County:	Kitsap
Site Owner:	North Kitsap School District 18360 Caldart Avenue NE Poulsbo, WA 98370 (360) 394-2643
Site Contacts:	North Kitsap School District Robin Shoemaker Director of Capital Programs 18360 Caldart Avenue NE Poulsbo, WA 98370 (360) 394-2643
	United States Army Corps of Engineers Jonathan Maas Seattle District Office 4735 E. marginal Way Seattle, WA 98134-2329 (206) 764-6745

2.2 SITE DESCRIPTION

Nike Site #92 is a former missile launch site located in Kingston, Washington, that operated from approximately 1954 to 1975 (Figure 2-1). The site is located at an elevation of approximately 40 feet above mean sea level (USGS 1973). Land at the site slopes gently to the northwest. The site is bounded by forest to the west, north, and east, and by private property to the south. The site is accessed via a paved driveway running north from NE Kingston Road. Features at the site include the Spectrum Community School (a small alternative high school), the North Kitsap School District (NKSD) Bus Barn, the former Missile Assembly and Test Building, the former Fallout Shelter, and two sealed missile magazines (i.e., underground missile storage areas; Figure 2-2).

Nike Site #92 was a part of a missile-based air defense system developed by the United States Army under the Continental Air Defense Command (Law 1986). Nike bases were a part of a national system designed to protect major metropolitan areas from air attack (Law 1986). In order to protect these metropolitan areas, several Nike bases were placed strategically around each area, forming a ring. For the Puget Sound basin, a total of 11 Nike sites were installed. Nike Site #92 is one of these installations. Generally, each Nike site or battery contained two spacially separate units: the Launcher Area and the Integrated Fire Control Area (Law 1986). Often a third facility, used for housing and known as the Facility Area, also was included in a battery (Law 1986). Nike Site #92 included all three of these areas, however, the PA/SI is concerned only with the Launcher Area.

Originally, Nike sites were designed to use Ajax missiles (ESEI 1984). Since the Ajax missiles had performance limitations which would prevent them from engaging formations of high speed, high altitude aircraft which would soon be in use, a second generation Nike system was developed using new, more advanced Hercules missiles which were faster and wider ranging (ESEI 1984). Design guidelines for the Nike Hercules missile provided for maximum use of proven components from the Nike Ajax program and stipulated that both missiles must be compatible with all sets of ground and launching equipment (Law 1986). As a result, a minimal amount of modification of the battery units was required to convert from the Nike Ajax to the Nike Hercules system (Law 1986). All the Ajax and Hercules batteries were essentially the same in design and construction (ESEI 1984).

2.3 SITE OWNERSHIP HISTORY

Acreage for the site was acquired by the United States Department of Defense (DoD) between 1954 and 1969 (Law 1988). The facility was deactivated in approximately 1975. In 1976, the property

was sold to the NKSD (Law 1988). The NKSD still holds title to the land. This entity is considering building a new high school on the property.

2.4 SITE OPERATIONS AND WASTE CHARACTERISTICS

Nike Site #92 was a missile launch facility. The Launcher Area of a Nike site was the location where the missiles and warheads were assembled, maintained, and prepared for firing. The missiles arrived at the site disassembled into component parts. All operations necessary to make the missiles flight ready were then conducted at the Launcher Area. (Law 1986)

The facility originally was designed for launching Nike Ajax missiles (Law 1986). The site was redesigned by 1961 for launching the larger, wider-ranging Nike Hercules missiles (WSDOT 1961). The Ajax missiles used a highly reactive liquid rocket propellant that consisted of unsymmetrical dimethylhydrazine (UDMH), inhibited red fuming nitric acid, aniline, furfuryl alcohol, and ethylene oxide (Law 1986). Since these compounds presented fire and personnel safety hazards, their use was governed by strict handling protocols (Law 1986). The Nike Hercules missiles used a solid rocket propellent that consisted of ammonium perchlorate (ESEI 1984). All deployed Hercules missiles utilized sealed solid propellents with essentially no potential for release (Law 1986). START-2 discussions with former workers at Nike Site #92 indicate that the liquid Ajax missile fuel was handled with extreme care due to its highly reactive nature by specially trained personnel brought in from nearby military bases. Further, the START-2 confirmed with former workers that the solid rocket propellants used in the Hercules missiles were not handled at the base, but as indicated in available literature, arrived as a component of the missile. Additionally, as indicated in available literature, the START-2 confirmed with former workers that no missile test firing occurred at Nike Site #92.

Nike Site #92, as originally designed, contained two missile magazines; a Missile Assembly and Test Building; a Warheading Building and Acid Fueling Area; an Acid Storage Shed; an Ethylene Oxide Storage Shed; a Paint, Oil, and Lubricant Storage Shed; an Auto Shop; a Generator Building; an Acid Neutralizing Pit; six underground fuel storage tanks, Barracks and associated support structures (i.e., latrine, recreation building, etc.); and Sentry Buildings (Figure 1-3; Walker 1956, Law 1986). When the facility was redesigned to use Hercules missiles, canine kennels were constructed for guard dogs, the original Warheading Building was demolished and a new building constructed, and the Acid Neutralizing Pit was covered (WSDOT 1961). The Acid Storage Shed and Ethylene Oxide Storage Shed, although no longer required for the Hercules missile fueling systems, remained intact at the site. It is not known whether these sheds were used for any subsequent purpose. By 1966, a Fallout Building had been

constructed at the site near the Barracks (WSDOT 1966). A Former Petroleum, Oil, and Lubricant (POL) Storage Area was once present at the site near the Auto Shop. The period of use for this storage area could not be determined from available information.

Petroleum products were used in the maintenance of base vehicles and missiles, and in supplying fuel for generators and heaters. Cleaning solvents were used in vehicle and missile maintenance. In general, the types of solvents used at Nike sites were Stoddard-type solvents (petroleum distillate), carbon tetrachloride, trichloroethane(s), perchloroethene, and trichloroethene. Painting of missile components involved the use of paints containing heavy metals. (Law 1986)

2.5 SITE CHARACTERIZATION

This subsection describes previous investigations and the START-2 site visit.

2.5.1 Previous Investigations

This subsection describes investigations previously conducted at Nike Site #92.

2.5.1.1 Law Engineering and Testing Company - 1988 Investigation

In 1988, Law Engineering and Testing Company completed an investigation of Nike Site #92 conducted for the United States Army Corps of Engineers (USACE) under DoD's Defense Environmental Restoration Program. The purpose of the investigation was to determine the potential for toxic or hazardous contamination at the site. The investigation included installing and sampling four groundwater monitoring wells (all have been abandoned with the exception of one which could not be located), sampling an existing water supply well (formerly used to supply water at the base), and sampling surface soils. Samples were analyzed for purgeable aromatics, purgeable halocarbons, total metals, petroleum hydrocarbons (waters only), and base/neutral extractables (one soil sample collected near a transformer), and polychlorinated biphenyls (one soil sample collected near a transformer). (Law 1988)

Analytical results indicated detections of methylene chloride and metals only. The methylene chloride results appeared to be due to laboratory contamination based on its presence in QA samples including equipment rinsate blanks, travel blanks, and laboratory method blanks. Further, concentrations of methylene chloride in the QA samples were generally higher than in the field samples. Metals concentrations in groundwater and soil were generally low and within natural background levels. (Law 1988)

2.5.1.2 White Shield, Inc. - 1993 Closure Site Assessment Report

In the summer of 1992, the six underground fuel storage tanks were removed by White Shield, Inc., for the USACE: one at the Missile Assembly and Test Building, four at the Generator Building, and one at the Barracks Building. The tanks were removed in accordance with EPA and Washington state regulations. Tank excavations were sampled and analyzed for total petroleum hydrocarbons. Test results showed that soil in two of the tank excavations at the Generator Building were contaminated with diesel above Model Toxics Control Act Method A Clean-Up Levels. (White Shield 1993)

Although groundwater samples were not collected as a part of this investigation, results from a monitoring well installed in this area and sampled during the 1988 investigation conducted by Law Engineering and Testing Company did not contain petroleum hydrocarbons above detection limits. These test results indicate that groundwater near the Generator Building was not being impacted by nearby petroleum contaminated soils.

2.5.1.3 USACE - 1995 Petroleum Contaminated Soil Sampling

In March 1995, the USACE had three test pits dug adjacent to one of the two contaminated tank excavations at the Generator Building. Both field screening and confirmation samples were collected from the test pits. Confirmation sample results were not reported and could not be located. Field screening results detected less than 10 ppm petroleum hydrocarbons in one test pit. The second tank excavation showing diesel contamination was not re-investigated. Although records do not indicate why this excavation was not reinvestigated, it is likely it was not addressed because soils in this excavation only marginally exceeded (i.e., by 1 part per million [ppm]) the regulatory level. (USACE 1995)

2.5.1.4 Kane Environmental, Inc. - 2004 Environmental Site Investigation

In November 2003 and February 2004, Kane Environmental, Inc., conducted sampling at the site for the NKSD as a part of the environmental impact statement for the proposed work related to constructing a new high school on the Nike Site #92 property. Fieldwork included drilling soil boreholes with a hallow stem auger for soil and groundwater sample collection. Additionally, soil samples were collected from boreholes drilled with a Geoprobe®. Groundwater also was collected from the Geoprobe locations when it was present. Kane Environmental, Inc. collected environmental samples from the following areas on Nike Site #92: Former Auto Shop, the Former Warheading Building/Acid Fueling Area, the Missile Assembly and Test Building, the Former POL Storage Area, the primary septic system, and from the approximate location of a buried ditch that originally circumvented the perimeter of the

missile magazines. Samples were analyzed for volatile organic compounds (VOCs), diesel and oil range total petroleum hydrocarbons, semivolatile organic compounds (SVOCs), ethylene oxide, ammonium perchlorate, hydrazines, chlorinated herbicides, chromium VI, arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. (Kane 2004)

Several metals were detected in soil and groundwater throughout the site. In many cases, the concentrations of metals detected in groundwater exceeded state cleanup levels (i.e., Washington State Model Toxics Control Act Method A or B Cleanup Levels). Kane Environmental, Inc., concluded that these concentrations above state cleanup levels were most likely attributable to the dissolution of metals in suspended soil particles following the introduction of nitric acid (by field personnel for sample preservation purposes) into the groundwater samples. In soil samples, only one detection of a metal, cadmium at the Former Auto Shop, exceeded a state cleanup level. Additionally, laboratory results indicated detected concentrations of bis-2-ethylhexylphalate and methylene chloride at several soil and groundwater locations throughout the site. These analytes are not known to be associated with Nike facility activities and are commonly associated with laboratory contamination. Acetone was detected in two Geoprobe boreholes located along the buried missile magazine perimeter ditch. Several SVOCs were detected in one shallow subsurface soil sample (2.5 feet below ground surface [bgs]) collected near the Former Warheading Building. These compounds were not present at deeper sample intervals. Finally, perchlorate was detected at an estimated concentration in one shallow subsurface soil sample (2.5 feet bgs) collected near the Former POL Storage Area. (Kane 2004)

Based on their investigations of soil and groundwater quality at the site, Kane Environmental, Inc., suggested that the contaminants of concern for the site do not pose a risk to human health and the environment. For this reason, they recommended no further action to evaluate soil and groundwater quality at the site. (Kane 2004)

2.5.2 START-2 Site Visit

On December 11, 2003, the START-2 conducted a site visit of Nike Site #92. A follow-up site visit was conducted on February 24, 2004, to view the interior of the Missile Assembly and Test Building which was not accessible at the time of the initial site visit. As a part of the initial site visit, photographs of the grounds were taken (Appendix A). Features remaining at the site that were once associated with DoD activities include the Fallout Shelter, water supply tanks, barracks, septic system, Missile Assembly and Test building, concrete footing of the Former Auto Shop, and sealed missile magazines (Figure 2-2).

The Fallout Shelter is a cinder block structure. Power lines in circuit breaker boxes at the

structure have been cut. No soil staining or stressed vegetation was present around the structure. Two water supply tanks are located east of the Fallout Shelter. The concrete footing of the former pump house is still present. The barracks currently are being used by the Spectrum Community School.

The Auto Shop has been demolished. Only the concrete footing remains. A 3 to 4-foot pile of dirt has been placed on this footing. No evidence exists of the Former POL Storage Area which presently is covered by grass. The Missile Assembly and Test Building also is a cinder block structure. A floor drain is present in the bathroom of this building. No other floor drains were observed, however, the NKSD currently is using this structure for storage which covers approximately 50% of the available floor space. Available as-builts for this structure do not indicate floor drains other than the one in the bathroom. There is a 55-gallon drum resting on the concrete drive south of this building. The drum appears to be full and has a faded label that reads "Texaco, RINDO HD 68, TS0908, 1658 NF". The drum, while rusting, does not appear to be leaking. There is a pile of debris on the northwest corner of the Missile Assembly and Test Building that primarily contains metal lockers in addition to a desk, a couch, and steel beams. A 250-gallon propane tank, that seemed empty when tapped, is present on the north side of this building.

The START-2 located several features associated with the septic system. A 750-gallon septic tank and septic lift pump are present north of the Former POL Storage Area. These features are tied into the primary septic tank and drain field located near the former barracks via a pressurized septic line. The tank and lift pump were used to convey sewage from the Missile Assembly and Test Building to the primary septic system for treatment. The primary septic system drain field is covered by grass and shrubs which did not appear to be distressed. A concrete rectangular vault measuring approximately 3 feet by 8 feet and having a 6-inch pipe portal on the north interior wall is present at the base of the septic drain field to the southwest. The vault contained approximately 2.5 feet of water. The START-2 could not discern whether the vault had a soil or concrete bottom due to the presence of a vegetative layer in the bottom of the vault. A review of aerial photographs from 1961 and 1966 show a road or ditch between the Former Auto Shop/Former POL Storage Area and this vault. It is possible this vault was used to dispose waste to the septic drain field. The original intended purpose of this vault could not be determined.

The missile magazines are partially covered by a gravel pad and partially covered by asphalt. The NKSD is using this area to park school buses. The missile magazines contained sumps to collect water that infiltrated the structure and to collect other liquids used or stored in the magazine. Water from the sump, which may have contained contaminants, was pumped to the surface and discharged, possibly to a ditch that circumvented the perimeter of the magazines. The START-2 observed two 10-inch

corrugated steel pipes in a marshy depression approximately 100 feet west of the missile magazines. Both pipes discharge to a wetland (Northwest Wetland) located west of the marshy depression. The purpose of these pipes could not be determined, however, it is possible given their location and orientation that they were used to convey water from the missile magazines perimeter ditch to the wetland.

An area measuring approximately 150 feet by 70 feet north of the sealed magazines contains mounds of demolition debris. West of the missile magazine are two 5-foot by 5-foot by approximately 5-foot deep concrete vaults. These vaults were electric junction boxes used in supplying power from the generator building to the magazines. The vaults were dry and contained some vegetative matter. Both were covered with a steel lid.

The START-2 also viewed a small marshy pond located southeast of the Former POL Storage Area reported by adjacent property owners to have contained a white residue and stressed vegetation during the summer of 2003. At the time of the START-2's site visit in December 2003, no white residue was present.

2.6 SUMMARY OF PA/SI INVESTIGATION LOCATIONS

Sampling under the PA/SI was conducted at possible sources of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) -regulated hazardous substances and at areas (i.e., targets) that may have been contaminated through the migration of hazardous substances from site sources. The features identified for inspection under the Nike Site #92 PA/SI were determined based on site visits, interviews with former workers, and a review of background information, as-builts, and aerial photographs. These features are discussed below:

Potential Sources

- **Former Acid Neutralizing Pit.** The Former Acid Neutralizing Pit was used to neutralize waste liquid rocket fuel associated with the Ajax Missiles. This pit also may have been used to dispose of other wastes. This investigation will assist in determining whether this pit is a source of contamination. Probable contaminants of concern are VOCs, SVOCs including nitrosodimethylamine, Target Analyte List (TAL) metals, perchlorate, and hydrazines.
- **Former Warheading/Acid Fueling Area.** The Former Warheading/Acid Fueling Area may have received minor spills during fueling operations. This investigation will assist in determining whether this area is a source of contamination. Probable contaminants of concern are VOCs, SVOCs including nitrosodimethylamine, TAL metals, perchlorate, and hydrazines.

- **Missile Assembly and Test Building.** The floors of the Missile Assembly and Test Building may have been rinsed out the bay doors. Contaminants associated with maintenance of the missiles may have contaminated adjacent soils under the concrete pads. This investigation will assist in determining whether this area is a source of contamination. Probable contaminants of concern are VOCs, SVOCs including nitrosodimethylamine, TAL metals, perchlorate, and hydrazines.
- **Former Auto Shop.** The Former Auto Shop was used to repair and maintain vehicles at the Launch Facility. During these activities, petroleum and solvent related compounds may have spilled to the ground. This investigation will assist in determining whether this area is a source of contamination. Probable contaminants of concern are VOCs, SVOCs, and TAL metals.
- **Former POL Storage Area.** The Former POL Storage Area was used to store drums of petroleum, oil, and lubricants. It is possible that waste solvents also were stored in this area. Drums may have spilled or leaked to the ground. Probable contaminants of concern are VOCs, SVOCs, and TAL metals.
- **Septic System.** The septic system may have been used to dispose of wash water from the Missile Assembly and Test Building or to dispose of other site-related contaminants. Aerial photographs of the site indicate a concrete vault at the base of the septic drain field may have been used for disposal purposes. This investigation will assist in determining whether this system is a source of contamination. Probable contaminants of concern are VOCs, SVOCs including nitrosodimethylamine, TAL metals, perchlorate, and hydrazines.

Targets

- **Northwest Wetland/Marshy Pond.** An isolated wetland (Northwest Wetland) is adjacent to the site. Pipes present near the wetland leading from the missile magazine area indicate it may have been used for disposal of surface water from the magazine perimeter ditch. Additionally, a marshy pond is present on the west side of the site near the forest's edge. Adjacent property owners previously have observed a white residue in this pond. This investigation will assist in determining whether sediments in the wetland and marshy pond have elevated concentrations of contaminants. Potential contaminants of concern are VOCs, SVOCs including nitrosodimethylamine, TAL metals, perchlorate, and hydrazines.
- **Groundwater and Drinking Water Wells.** Groundwater at the site is shallow, occurring at depths ranging from 11 to 28 feet bgs. Approximately 1,000 domestic drinking water wells and seven municipal wells are present within 4 miles of the site. Many domestic wells draw from groundwater less than 100 feet bgs. It is possible that groundwater may have become contaminated as a result of site activities. This investigation will assist in determining whether groundwater near the site has elevated concentrations of contaminants. Potential contaminants of concern are VOCs, SVOCs including nitrosodimethylamine, TAL metals, perchlorate, and hydrazines.

3. FIELD ACTIVITIES AND ANALYTICAL PROTOCOL

A sampling and quality assurance plan (SQAP) for the Nike Site #92 project was developed by the START-2 prior to field sampling (E & E 2004). The SQAP describes the sampling strategy, sampling methodology, and analytical program used to investigate potential hazardous substance sources and potential targets. With few exceptions, PA/SI field activities were conducted in accordance with the approved SQAP. Deviations from the SQAP are described, when applicable, in this section and in the sampling location discussions in Section 6 (source areas) and Section 7 (target areas). All deviations to this SQAP were pre-approved by the EPA Task Monitor (TM) during the field sampling event.

The PA/SI field sampling event was conducted from April 27, 2004 through May 5, 2004. A total of 28 samples, including four background samples and four QA (rinsate and trip blank) samples, were collected for the PA/SI. In some cases, not all groundwater sample aliquots for a specific location could be collected in the same day. When this occurred, the aliquot was given a separate sample number as described in greater detail in subsection 7.1.1 of this report. Sample types and methods of collection are described below. A list of all samples collected for laboratory analysis under the PA/SI is contained in Table 3-1. Photographic documentation of PA/SI field activities is included as Appendix A.

Alphanumeric identification numbers applied by the START-2 to each sample location (e.g., SD02) are used in the report as the sample location identifiers. Sample locations are provided in Figure 3-1.

This section describes sampling methodology (subsection 3.1), analytical protocol (subsection 3.2), global positioning system (subsection 3.3), land surveying and utility locate (subsection 3.4), and investigation-derived waste (subsection 3.5).

3.1 SAMPLING METHODOLOGY

Grass, leaves and other vegetative material, rocks, and other debris unsuitable for analysis were removed from samples before being placed into sample containers. Samples were stored on ice in coolers continuously maintained under the custody of START-2 personnel. Sampling methods used for each sample type are described below.

3.1.1 Subsurface Soil Sampling

A total of nine subsurface soil samples were collected. Subsurface soil samples were collected using a truck-mounted Geoprobe™ hydraulically push-driven drill rig. Subsurface soil samples were collected over 1.5- to 4-foot intervals from depths ranging from 8 to 13 feet bgs. Prior to sampling, material in the acetate sleeve was screened for organic compounds using a photoionization detector/flame ionization detector (PID/FID). Results for PID/FID field screening are discussed in subsection 6.1.2. Sample material for VOCs analysis was collected directly from the acetate sleeve with a stainless steel spoon. The remaining sample material from the acetate sleeve was placed in a dedicated stainless steel bowl, homogenized, and then transferred into appropriate sample containers using a dedicated stainless steel spoon.

3.1.2 Sediment Sampling

A total of five sediment samples were collected. Sediment samples were collected using dedicated stainless steel spoons. All sediment samples were collected below water in wetlands or ponds from 0 to 6 inches bgs in the sediment. Aliquots for VOCs analysis were placed directly into sample containers using dedicated stainless steel spoons. Material for the remaining analyses was collected into a dedicated stainless steel bowl, water in the bowl was decanted, the material was homogenized, and then transferred into appropriate sample containers using a dedicated stainless steel spoon.

3.1.3 Groundwater Monitoring Well Sampling

A total of three monitoring wells were sampled. Monitoring wells were installed using a truck-mounted Geoprobe™ hydraulically push-driven drill rig. Monitoring wells were installed by pushing a 4-inch diameter steel casing into the ground to the desired depth of the well. A 1.5-inch diameter polyvinyl chloride schedule 40 pipe with attached 10-foot screen was inserted in the casing. The well was then filled with Colorado sand from the top of the screen to within two feet of the ground surface as the casing was pulled from the borehole. The remaining space was filled with Quickgrout to seal off the well. Once the well was in place, the 4-inch diameter steel casing was removed. All screens were installed near the top of the water table. In the case of monitoring well MW03, a 5-foot screen was installed since additional screen was not available at the time of drilling. Appendix B provides monitoring well boring logs which include well construction details.

Following well purging and development, groundwater samples were collected using an inertia pump with dedicated Teflon tubing. Groundwater samples were collected using low-flow sampling

techniques to minimize agitation of the samples. Samples were collected from each monitoring well once at least three volumes of water had been evacuated and groundwater quality parameters (i.e., pH, conductivity, temperature) had stabilized. At this point, the groundwater samples were collected directly from the Teflon tube into sample containers. Sample aliquots for VOCs and TAL metals analysis were collected into pre-preserved sample containers. Following sampling, all monitoring wells were abandoned in place in accordance with Washington state regulations.

3.1.4 Groundwater Drinking Water Sampling

A total of seven drinking water wells were sampled. Drinking water wells were allowed to purge until groundwater quality parameters (i.e., pH, conductivity, and temperature) had stabilized. Whenever possible, drinking water samples were collected directly from a spigot at the well head into sample containers. When the spigot was too low to be sampled from (i.e., at wellhead spigots for samples DW01, DW04, and DW07), samples were collected from the hose used in purging. All samples were collected prior to chlorination units when present. Sample aliquots for VOCs and TAL metals analysis were collected into pre-preserved sample containers.

3.2 ANALYTICAL PROTOCOL

Analytical methods applied to PA/SI samples include fixed laboratory analysis of VOCs (EPA CLP SOW OLM04.3 for soils and EPA CLP SOW OLC03.2 for low concentration organic analyses in water), SVOCs (CLP OLM04.3 with low concentrations for waters), TAL metals (CLP SOW ILM05.3 with low concentrations for waters), perchlorate (EPA Method 314.0), nitrosodimethylamine (EPA SW-846 Method 8270), and hydrazines (internal laboratory method STL SOP DEN-WC-0048H). The types of analysis applied to samples were based on known or suspected contaminants. For this reason, some samples were not analyzed for all of the analytical methods listed above. Analyses of samples collected during the PA/SI for VOCs, perchlorate, and nitrosodimethylamine were performed by the EPA Manchester Environmental Laboratory located in Port Orchard, Washington. Analyses of samples for SVOCs and TAL metals were performed by CompuChem Laboratory, an EPA Contract Laboratory Program (CLP) laboratory located in Cary, North Carolina. Analysis of samples for hydrazines was performed by STL-Denver Laboratory located in Arvada, Colorado, a commercial laboratory that was subcontracted by the START-2.

3.3 GLOBAL POSITIONING SYSTEM

Trimble Pathfinder Professional Global Positioning System (GPS) survey units and Corvalis data loggers were used by the START-2 personnel to approximate the sample location coordinates of the PA/SI samples. Recorded GPS coordinates by sample point are listed in Appendix C.

3.4 LAND SURVEY AND UTILITY LOCATE

The START-2 subcontracted a land surveyor, AES Consultants Professional Land Surveyors from Silverdate, Washington, to locate former features and monitoring wells. The land surveyor determined the corners of the Former Warheading Building and the Former Acid Neutralizing Pit. The land surveyor also determined the horizontal and vertical coordinates of the three monitoring wells installed during the PA/SI.

The START-2 arranged to have all underground utilities located at proposed borehole and monitoring well locations prior to drilling. Both the State of Washington utility locating service and a private utility locator hired by the START-2 (Locating, Inc., from Issaquah, Washington) were used to locate on- and off-site utilities.

3.5 INVESTIGATION-DERIVED WASTE

Investigation-derived waste (IDW) generated during the PA/SI sampling effort consisted of purge water from monitoring wells, decontamination water from cleaning of Geoprobe rods, solid disposable sampling equipment, and disposable personal protection equipment. IDW generated in association with Geoprobe work (i.e., monitoring well purge water, decontamination water, and disposable sampling equipment) was contained in two steel drums (one 55-gallon drum and one 85-gallon drum) and staged on site for subsequent disposal in a Resource Conservation and Recovery Act waste handling facility. IDW from other sampling activities (i.e., sediment and drinking water sampling) was disposed as non-hazardous waste by the START-2 at the local municipal landfill in Kingston, Washington.

Table 3-1

SAMPLE COLLECTION AND ANALYTICAL SUMMARY
NIKE SITE #92
PRELIMINARY ASSESSMENT/SITE INSPECTION
KINGSTON, WASHINGTON

EPA Sample ID	CLP Organic ID	CLP Inorganic ID	Station Location ID	Matrix	Date	Time	Depth (feet bgs)	Analysis							Description
								VOCs	SVOCs	TAL Metals (AES)	TAL Metals (MS)	Perch-lorate	Hydra-zines	Nitrosodi-methylamine	
04184000	J2C17	MJ2C17	SD02	SD	4/27/04	0915	0-0.5	X	X	X		X	X	X	Sample collected from Northwest Wetland within 10 feet of discharge pipe. Sample is wet, dark brown, silty sand with organic material.
04184001	J2C18	MJ2C18	SD03	SD	4/27/04	0850	0-0.5	X	X	X		X	X	X	Sample collected from Northwest Wetland within 5 feet of discharge pipe. Sample material is wet, dark brown, silty sand with organic material. Strong organic odor.
04184002	J2C19	MJ2C19	SD04	SD	4/27/04	1135	0-0.5	X	X	X		X	X	X	Sample collected from west side of Northwest Wetland near outflow channel. Wet, dark brown, silty sand with clay and organic material, no odor.
04184003	J2C20	MJ2C20	SD05	SD	4/27/04	1415	0-0.5	X	X	X		X	X	X	Sample collected from small marshy pond at location of formerly observed white residue. Wet, dark brown, sandy silt with some clay, some organic material, no odor.
04184004	J2C21	MJ2C21	DW01	GW	4/27/04	1600	NA	X	X	X	X	X		X	Background drinking water sample collected from a residence in the 9200 block of NE West Kingston Rd. Clear water with sulfur odor.
04184005	J2C22	MJ2C22	DW02	GW	4/27/04	1640	NA	X	X	X	X	X		X	Drinking water sample collected from a residence in the 26300 block of Barber Cut-off Rd NE. Clear water with sulfur odor.
04184006	J2C23	MJ2C23	SB01SS11	SB	4/27/04	1025	8-11	X	X	X		X	X	X	Background Geoprobe subsurface soil sample collected from a residence in the 9200 block of NE West Kingston Rd. Light brown to brown sorted, silty sand, moist and saturated brown to gray sandy silt.
04184007	J2C24	MJ2C24	SB02SS11	SB	4/27/04	1540	8-12	X	X	X		X	X	X	Geoprobe subsurface soil sample collected from septic drainfield at 3 foot by 8 foot concrete vault. Brown-gray sandy-silt, sorted, with some clay, saturated. No odor.
04184008	NA	NA	TB01WA	WT	4/27/04	1320	NA	X							Trip blank sample.
04184009	NA	NA	TB02WA	WT	4/27/04	1325	NA	X							Trip blank sample.
04184010	J2C25	MJ2C25	RS01WA	WT	4/27/04	1710	NA	X	X	X	X	X		X	Rinsate blank of decontaminated Geoprobe rod.
04184011	J2C26	MJ2C26	SB04SS10	SB	4/28/04	0815	8.5-10	X	X	X					Geoprobe subsurface soil sample collected from Former POL Storage Area. Light gray, sandy-silt, with some gravel and clay, moist.
04184012	J2C27	MJ2C27	SB05SS10	SB	4/28/04	0845	8-10	X	X	X					Geoprobe subsurface soil sample collected from Former Auto Shop. Medium brown silty-sand, sorted with some coarse material, moist.
04184013	J2C28	MJ2C28	SB06SS10	SB	4/28/04	0915	8-10	X	X	X		X	X	X	Geoprobe subsurface soil sample collected from Septic Tank area. Medium-brown, sandy-silt with some clay. Slightly moist.

Table 3-1

SAMPLE COLLECTION AND ANALYTICAL SUMMARY
NIKE SITE #92
PRELIMINARY ASSESSMENT/SITE INSPECTION
KINGSTON, WASHINGTON

EPA Sample ID	CLP Organic ID	CLP Inorganic ID	Station Location ID	Matrix	Date	Time	Depth (feet bgs)	Analysis							Description
								VOCs	SVOCs	TAL Metals (AES)	TAL Metals (MS)	Perch-lorate	Hydra-zines	Nitrosodi-methylamine	
04184014	J2C29	MJ2C29	SB03SS12	SB	4/28/04	1305	8-12	X	X	X		X	X	X	Geoprobe subsurface soil sample collected south of Former Warheading Building. Grey clay, sand, and silty-sand. Moist to wet.
04184015	J2C30	MJ2C30	SB07SS12	SB	4/28/04	1425	8-12	X	X	X		X	X	X	Geoprobe subsurface soil sample collected from inside the location of the Former Warheading Building. Grey clay and sandy-silt. Slightly moist.
04184016	J2C31	MJ2C31	SB08SS12	SB	4/28/04	1450	8-12	X	X	X		X	X	X	Geoprobe subsurface soil sample collected from the Missile Assembly and Test Building. Medium brown clay and gray clay. Wet to moist.
04184017	J2C32	MJ2C32	SB09SS13	SB	4/28/04	1600	10-13	X	X	X		X	X	X	Geoprobe subsurface soil sample collected from Former Acid Neutralizing Pit. Brown and gray sandy-silt, and brown/gray clay. Moist.
04184018	J2C33	MJ2C33	DW03	GW	4/28/04	1030	NA	X	X	X	X	X		X	North Kitsap Public Utility District Well #4 prior to chlorination unit. Clear water with no odor. MS/MSD
04184019	J2C35	MJ2C35	DW04	GW	4/28/04	1325	NA	X	X	X	X	X		X	Drinking water sample collected from a residence in the 26100 block of NE Barrett Rd. Rust colored water with no odor.
04184020	J2C36	MJ2C36	SD01	SD	4/28/04	1440	0-0.5	X	X	X		X	X	X	Background wetland sample collected from aproperty in the 26000 block of Barber Cut-off Rd NE. Wet, dark brown, silty material with some clay and organic matter. Organic odor. MS/MSD sample.
04184021	J2C37	MJ2C37	DW05	GW	4/28/04	1515	NA	X	X	X	X	X		X	Drinking water sample collected from a residence in the 26000 block of Barber Cut-off Rd. NE. Clear water with sulfur odor.
04184022	J2C34	MJ2C34	MW01	GW	4/28/04	1650	NA	X	X	X	X	X		X	Background monitoring well sample collected from a residence in the 9200 block of NE West Kingston Rd. Water is turbid.
04184023	J2C38	MJ2C38	DW06	GW	04/29/04	0835	NA	X	X	X	X	X		X	Drinking water sample collected from residence at 26200 block of NE Barrett Rd. Clear water with no odor
04184024	J2C39	MJ2C39	MW02	GW	04/29/04	1045	NA	X	X	X	X	X		X	Co-located with SB02SS11. Collected near septic drainfield at 3 foot by 8 foot concrete vault. Water is turbid.
04184025	J2C40	MJ2C40	DW07	GW	04/29/04	1430	NA	X	X	X	X	X		X	Drinking water sample collected from a residence in the 25800 block of Sowsear Lane NE. Clear water with no odor.
04184026	NA	NA	TB03	WT	4/30/04	1630	NA	X							Trip blank sample.
04184027	J2C41	NA	MW03	GW	04/30/04	1705	NA	X	X						Co-located with SB03SS12. Collected south of Former Warheading Building. Water is turbid.
04184028	NA	NA	MW03A	GW	5/01/04	0815	NA					X			Co-located with SB03SS12. Collected south of Former Warheading Building. Water is turbid.

Table 3-1

SAMPLE COLLECTION AND ANALYTICAL SUMMARY
NIKE SITE #92
PRELIMINARY ASSESSMENT/SITE INSPECTION
KINGSTON, WASHINGTON

EPA Sample ID	CLP Organic ID	CLP Inorganic ID	Station Location ID	Matrix	Date	Time	Depth (feet bgs)	Analysis							Description
								VOCs	SVOCs	TAL Metals (AES)	TAL Metals (MS)	Perch-lorate	Hydra-zines	Nitrosodi-methylamine	
04194000	NA	NA	MW03B	GW	5/2/04	0755	NA							X	Co-located with SB03SS12. Collected south of Former Warheading Building. Water is turbid.
04194001	NA	NA	DW01A	GW	5/5/04	1115	NA						X		Background drinking water sample collected from a residence in the 9200 block of NE West Kingston Rd. Clear water with sulfur odor.
04194002	NA	NA	DW02A	GW	5/5/04	0815	NA						X		Drinking water sample collected from a residence in the 26300 block of Barber Cut-off Rd NE. Clear water with sulfur odor.
04194003	NA	NA	DW03A	GW	5/5/04	1150	NA						X		North Kitsap Public Utility District Well #4 prior to chlorination unit. Clear water with no odor. MS/MSD
04194004	NA	NA	DW04A	GW	5/5/04	1010	NA						X		Drinking water sample collected from a residence in the 26100 block of NE Barrett Rd. Rust colored water with no odor.
04194005	NA	NA	DW05A	GW	5/5/04	0840	NA						X		Drinking water sample collected from a residence in the 26000 block of Barber Cut-off Rd. NE. Clear water with sulfur odor.
04194006	NA	NA	DW06A	GW	5/5/04	1040	NA						X		Drinking water sample collected from a residence in the 26200 block of NE Barrett Rd. Clear water with no odor. Sample container broke during shipment to the laboratory.
04194007	NA	NA	DW07A	GW	5/5/04	0920	NA						X		Drinking water sample collected from a residence in the 25800 block of Sowsear Lane NE. Clear water with no odor.

Key:

AES = Atomic emission spectrometry.
bgs = below ground surface.
CLP = Contract Laboratory Program.
E & E = Ecology and Environment, Inc.
EPA = United States Environmental Protection Agency.
GW = Groundwater.
ID = Identification.
MS = Mass spectrometry.
MS/MSD = Matrix spike/matrix spike duplicate.
NA = Not applicable.
NE = northeast.
POL = Petroleum, oil, and lubricant.
Rd = Road.
SB = Subsurface soil.
SD = Sediment.
TAL = Target Analyte List.
WT = Water.

4. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC data are necessary to determine precision and accuracy and to demonstrate the absence of interferences and/or contamination of sampling equipment, glassware, and reagents. Specific QC requirements for laboratory analyses are incorporated in the *Contract Laboratory Program Statement of Work for Organic Analyses* (EPA 1999a) and the *Contract Laboratory Program Statement of Work for Inorganic Analyses* (EPA 2002a). These QC requirements or equivalent requirements found in the analytical methods were followed for analytical work on the SI. This section describes the QA/QC measures taken for the SI and provides an evaluation of the usability of data presented in this report.

All samples were collected following the guidance of the SQAP (E & E 2004), the START-2 quality assurance project plan (QAPP; E & E 2003). Hydrazines analyses following STL SOP DEN-WC-0048H were performed by STL-Denver, Arvada, Colorado, a START-2 subcontracted commercial laboratory. TAL metals analyses following CLP SOW ILM05.3 and SVOC analyses following EPA CLP SOW OLM04.3 (water samples were submitted for low concentration analyses) were performed by Compuchem Laboratory, Cary, North Carolina, a CLP laboratory. Perchlorate analyses following EPA Method 314.0, VOC analyses following EPA CLP SOW OLM04.3 for soils and EPA CLP SOW OLC03.2 for low concentration organic analyses in water, and N-nitrosodimethylamine analyses following EPA SW-846 Method 8270 were performed by the EPA Manchester Environmental Laboratory, Port Orchard, Washington.

Data from the START-2 subcontracted commercial laboratory were reviewed and validated by a START-2 chemist. Data from the CLP and EPA laboratories were reviewed and validated by EPA chemists. Data qualifiers were applied as necessary according to the following guidance:

- EPA (2002b) *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*; and
- EPA (1999b) *Contract Laboratory Program National Functional Guidelines for Organic Data Review*.

In the absence of other QC guidance, method-specific QC limits were also utilized to apply qualifiers to the data.

4.1 SATISFACTION OF DATA QUALITY OBJECTIVES

The following EPA (EPA 2000) guidance document was used to establish data quality objectives (DQOs) for this SI:

- *Guidance for the Data Quality Objectives Process* (EPA QA/G-4), EPA/600/R-96/055.

The EPA TM determined that definitive data without error and bias determination would be used for the sampling and analyses conducted during the field activities. The data quality achieved during the fieldwork produced sufficient data that met the DQOs stated in the SQAP (E & E 2004). A detailed discussion of accomplished SI objectives is presented in the following subsections.

4.2 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

QA samples included rinsate and trip blank samples. One rinsate blank sample was collected from non-dedicated sampling equipment therefore meeting the frequency criteria of one rinsate blank per 20 samples per matrix. Rinsate blanks are discussed in subsection 4.4.3. Three trip blank samples were collected during the SI, meeting the frequency of one trip blank for each sample cooler shipped to the laboratories for VOC analysis. Trip blanks are discussed in subsection 4.4.4. QC samples included matrix spike (MS)/matrix spike duplicate (MSD) samples for organic analyses and MS/duplicate (DUP) samples for inorganic analyses at a rate of one MS/MSD or MS/DUP per 20 samples per matrix per analysis.

4.3 PROJECT-SPECIFIC DATA QUALITY OBJECTIVES

The commercial laboratory data were reviewed to ensure that DQOs for the project were met. The following describes the laboratories' ability to meet project DQOs for precision, accuracy and completeness and the field team's ability to meet project DQOs for representativeness and comparability. The laboratory and the field team were able to meet DQOs for the project.

4.3.1 Precision

Precision measures the reproducibility of the sampling and analytical methodology. Laboratory and field precision is defined as the relative percent difference (RPD) between duplicate sample analyses. The laboratory duplicate samples or MS/MSD samples measure the precision of the analytical method.

The RPD values were reviewed for all commercial laboratory samples. No sample results were qualified based on laboratory duplicate QC outliers. The DQO for precision of 85% was met.

4.3.2 Accuracy

Accuracy measures the reproducibility of the sampling and analytical methodology. Laboratory accuracy is defined as the deuterated monitoring compound (DMC)/system monitoring compound (SMC) spike percent recovery for organic analyses or the MS percent recoveries for all analyses. The DMC/SMC percent recovery values were reviewed for all appropriate sample analyses. Forty-four sample results (approximately 1.2 % of the data) were qualified as estimated quantities (J) based on DMC/SMC percent recovery outliers. The MS percent recovery values were reviewed for all MS/MSD analyses. Forty-three sample results (approximately 1.2 % of the data) were qualified as estimated quantities (J) based on MS percent recovery outliers. The project DQO for accuracy of 85% was met.

4.3.3 Completeness

Data completeness is defined as the percentage of usable data (usable data divided by the total possible data). All data were reviewed for usability. No sample results were rejected, therefore, the project DQO for completeness of 90 % was met.

4.3.4 Representativeness

Data representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point or environmental condition. The number and selection of samples were determined in the field to account accurately for site variations and sample matrices. The DQO for representativeness of 85 % was met.

4.3.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another. Data produced for this site followed applicable field sampling techniques and specific analytical methodology. The DQO for comparability was met.

4.4 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL PARAMETERS

The laboratory data also were reviewed for holding times, laboratory blank samples, rinsate blank samples, and trip blank samples. These QA/QC parameters are summarized below. In general, the laboratory and field QA/QC parameters were considered acceptable.

4.4.1 Holding Times

All sample results met QC holding time criteria.

4.4.2 Laboratory Blanks

All laboratory blanks met the frequency criteria. The following potential contaminants of concern were detected in the laboratory blanks and associated samples were qualified as not detected (U) or as an estimated quantity (J) as listed in the data validation memoranda:

SVOCs:	bis(2-ethylhexyl)phthalate;
TAL Metals:	arsenic, barium, thallium; and
VOCs:	acetone and methylene chloride.

4.4.3 Rinsate Blanks

The rinsate blank was collected by pouring distilled water through a Geoprobe rod that had been decontaminated in the field. No analytes were detected in the rinsate blank sample.

4.4.4 Trip Blanks

Three trip blank samples were collected during the field event, therefore, meeting the frequency criteria for VOC analysis of one sample per cooler. Trip blanks were collected from a distilled, deionized water source and were maintained with the sample containers. No VOCs were detected in any of the trip blank samples.

5. ANALYTICAL RESULTS REPORTING AND BACKGROUND SAMPLES

This section describes the reporting and methods applied to analytical results presented in Sections 6 and 7 of this report, and discusses background locations and sample results. Table 3-1 lists all samples collected for laboratory analysis.

5.1 ANALYTICAL RESULTS EVALUATION CRITERIA

Analytical results presented in the summary tables in Sections 6 and 7 show all analytes detected above laboratory detection limits in bold type. Analytical results indicating significant/elevated concentrations of contaminants in source samples (Section 6) and target samples (Section 7) with respect to background concentrations are shown underlined and in bold type. For the purposes of this investigation, significant/elevated concentrations are those concentrations that are:

- Equal to or greater than the sample's Contract Required Detection Limit (CRDL) or the sample quantitation limit (SQL) when a non-CLP laboratory was used; and
- Equal to or greater than the background sample's CRDL or SQL when the background concentration is below detection limits; or
- At least three times greater than the background concentration when the background concentration equals or exceeds the detection limits.

The analytical summary tables present all detected compounds, but only those detected analytes at potential sources and targets meeting the significant/elevated concentration criteria are discussed in the report text. All detected concentrations are also discussed for the background sample. When samples were diluted for re-analysis at a laboratory, the dilution results were considered for evaluation and are provided in the tables.

5.1.1 Sample Results Reporting

The analytes aluminum, calcium, iron, magnesium, potassium, and sodium are common earth crust elements. Based on EPA Region 10 policy, these common earth crust elements will not be discussed in this report.

5.2 BACKGROUND SAMPLES

A background soil sample was collected for comparison to each type of sample collected (i.e., subsurface soil, sediment, shallow groundwater, and drinking water). Results for the background sample are shown in the first column of the analytical results summary tables in Sections 6 and 7 for comparison against source/targets results.

5.2.1 Background Subsurface Soil

5.2.1.1 Sample Location

One background subsurface soil sample (SB01SS11) was collected from native soil approximately 0.06 mile west of the site (Figure 3-1). The sample appeared to consist of light brown to brown sorted, silty-sand and brown to gray sandy-silt, that was moist to saturated. The background soil type matched those of samples collected from potential sources.

5.2.1.2 Sample Results

Ten TAL metals were detected in the background surface soil sample (SB01SS11). VOCs, SVOCs, perchlorate, hydrazines, and nitrosodimethylamine were not detected in this sample. Sample results are presented in the first column of Table 6-1.

5.2.2 Background Sediment Sample

5.2.2.1 Sample Location

One background sediment sample (SD01) was collected from native sediment in a palustrine-forested wetland approximately 0.5 mile northeast of the site (Figure 3-1; Bartlett 1998). The sample appeared to consist of wet, dark brown, silty material with some clay and organic matter. The background sediment material matched that of samples collected from the Northwest Wetland and the marshy pond.

5.2.2.2 Sample Results

Nine TAL metals were detected in the background sediment sample (SD01). The SVOC 2-propanone also was detected in this sample. VOCs, perchlorate, hydrazines, and nitrosodimethylamine were not detected in the sample. Sample results are presented in the first column of Table 7-6.

5.2.3 Background Monitoring Well

5.2.3.1 Sample Location

One background monitoring well sample (MW01) was collected from a monitoring well installed approximately 0.06 mile west of the site (Figure 3-1). The sample was collected from shallow groundwater at the water table. The background monitoring well sample was collected at a depth similar to onsite monitoring well samples.

5.2.3.2 Sample Results

Six TAL metals were detected in the background monitoring well sample (MW01). VOCs, SVOCs, perchlorate, hydrazines, and nitrosodimethylamine were not detected in this sample. Sample results are presented in the first column of Table 7-4.

5.2.4 Background Drinking Water Well

5.2.4.1 Sample Location

One background drinking water well sample (DW01) was collected from a drinking water well located approximately 0.06 mile west of the site (Figure 3-2). The sample was collected from the shallow drinking water aquifer, which is the same aquifer as downgradient drinking water wells, with the possible exception of the sample collected from DW02 that likely is in a different deeper drinking water aquifer.

5.2.4.2 Sample Results

One TAL metal was detected in the background drinking water well sample (DW01). VOCs, SVOCs, perchlorate, hydrazines, and nitrosodimethylamine were not detected in this sample. Sample results are presented in the first column of Table 7-5.

6. POTENTIAL SOURCES

This section describes potential sources, sample locations, and analytical results of PA/SI samples obtained from potential sources. Laboratory data sheets of analytical results for all samples are in Appendix D.

6.1 SOURCE DESCRIPTIONS

The site contains several areas that may be associated with CERCLA hazardous substance contamination. Each potential source is briefly described below:

- **Former Acid Neutralizing Pit.** The Former Acid Neutralizing Pit measures approximately 5 feet by 40 feet and was used to neutralize waste liquid rocket fuel associated with Ajax missiles. This pit also may have been used to dispose of other wastes. The pit was filled and covered when the facility was redesigned to support Hercules missiles. The pit is located in the area currently being used as the NKSD bus barn. The area of the former pit is covered by asphalt.

- **Former Warheading/Acid Fueling Area.** The Former Warheading/Acid Fueling Area may have received minor spills during fueling operations. The Former Warheading Building measured approximately 20 feet by 40 feet. This building has been removed. Currently, the eastern half of the location of this former building is covered by asphalt of the NKSD bus barn. The western half consists of exposed soil. No signs of soil staining or stressed vegetation are present in this area.

- **Missile Assembly and Test Building.** The floors of the Missile Assembly and Test Building may have been rinsed out the bay doors onto driveway pads leading to the doors. Contaminants associated with maintenance of the missiles may have contaminated adjacent soils under the concrete foundation or driveway pads. The Missile Assembly and Test Building still is present at the site and is being used by the NKSD to store miscellaneous items. The NKSD is in the process of removing the contents of the building in preparation of impending building demolition. The Missile Assembly and Test Building measures approximately 40 feet by 40 feet.

- **Former Auto Shop.** The Former Auto Shop was used to repair and maintain vehicles at the Launch Facility. During these activities, petroleum and solvent related compounds may have spilled to the ground. Currently, all that remains of the Former Auto Shop is the concrete foundation which measures approximately 15 feet by 25 feet.
- **Former POL Storage Area.** The Former POL Storage Area was used to store drums of petroleum, oil, and lubricants. It is possible that waste solvents also were stored in this

area. Drums may have spilled or leaked to the ground. This area measured approximately 25 feet by 100 feet. Currently, this area is the location of a grass field. No signs of soil staining or stressed vegetation are present in this area.

- **Septic System.** The septic system may have been used to dispose of wash water from the Missile Assembly and Test Building or to dispose of other site-related contaminants. The Septic System consists of a large primary septic vault with a mounded drain field located near former Barracks buildings. Currently the drain field, measuring 110 feet by 140 feet, is covered with bushes and grass. Additionally, a septic line runs from the Missile Assembly and Test Building to a 750-gallon septic holding tank and ultimately to the primary septic vault. Aerial photographs of the site indicate a concrete vault at the base of the septic drain field may have been used for disposal purposes. This Septic System is no longer in use. No signs of soil staining or stressed vegetation are present at the septic drain field.

Sample locations and analytical results of samples collected from potential sources at the site are presented in the following subsections.

6.1.1 Sample Locations

A total of eight subsurface soil samples (SB02SS11, SB03SS12, SB04SS10, SB05SS10, SB06SS10, SB07SS12, SB08SS12, and SB09SS13) were collected from potential sources at the site to determine whether CERCLA hazardous substances are associated with these source areas (Figure 3-1). Sample SB02SS11 was collected south of the 3 by 8 foot open concrete vault near the septic drain field. Sample SB03SS12 was collected south of the Former Warheading Building while sample SB07SS12 was collected from within the former location of the building's foundation. Sample SB04SS10 was collected from within the location of the Former POL Storage Area. Sample SB05SS10 was collected immediately east of the Former Auto Shop. Sample SB06SS10 was collected immediately south of the 750-gallon septic holding tank. Sample SB08SS12 was collected north of the Missile Assembly and Test Building adjacent to the building's northern bay door and beneath the concrete pad in this area. Sample SB09SS13 was collected within the location of the Former Acid Neutralizing Pit. Only two feet of soil was retrieved from the targeted sample interval of 8 to 12 feet bgs. Since this volume was insufficient to fill all required sample containers, this location was overdrilled by one foot (i.e., to 13 feet bgs) to allow for adequate soil recovery.

6.1.2 Sample Results

All subsurface soil samples were field screened for organic compounds with a PID/FID. Sample results for subsurface soil samples SB01SS11, SB02SS11, SB03SS12, SB06SS10, SB07SS12, SB08SS12, and SB09SS13 were below 1 ppm. Sample results for SB04SS10 and SB05SS10 were up to 17 ppm and up to 16 ppm, respectively. These samples were collected in the Former POL Storage Area and near the Former Auto Shop. The response time of the PID/FID for these two samples was slow which is consistent with typical responses from weathered fuel.

Sample results from fixed laboratory analysis are summarized in Table 6-1. With the exception of the VOC 2-propanone at SB04SS10 collected from the Former POL Storage Area, no analytes were detected at significant concentrations in subsurface soil samples SB02SS11 (collected at the septic drainfield), SB04SS10, SB05SS10 (collected near the Former Auto Shop), or SB06SS10 (collected near the Septic Tank). SB03SS12, collected south of the Former Warheading Building, contained significant concentrations of copper and 2-propanone. SB07SS12, collected from within the location of the Former Warheading Building, contained significant concentrations of copper, mercury, 2-butanone, 2-propanone, and carbon disulfide. SB08SS12, collected near the Missile Assembly and Test Building, contained significant concentrations of copper, mercury, 2-propanone, carbon disulfide, and trichloroethene. Finally, SB09SS13, collected from the Former Acid Neutralizing Pit, contained significant concentrations of mercury and 2-propanone.

SVOCs, perchlorate, hydrazines, and nitrosodimethylamine were not detected in any of the subsurface soil samples.

Table 6-1

SOURCE SAMPLES ANALYTICAL RESULTS SUMMARY
NIKE SITE #92 PRELIMINARY ASSESSMENT/SITE INSPECTION
KINGSTON, WASHINGTON

EPA Sample ID	04184006	04184007	04184014	04184011	04184012	04184013	04184015	04184016	04184017
CLP Organic ID	J2C23	J2C24	J2C29	J2C26	J2C27	J2C28	J2C30	J2C31	J2C32
CLP Inorganic ID	MJ2C23	MJ2C24	MJ2C29	MJ2C26	MJ2C27	MJ2C28	MJ2C30	MJ2C31	MJ2C32
Station Location	SB01SS11	SB02SS11	SB03SS12	SB04SS10	SB05SS10	SB06SS10	SB07SS12	SB08SS12	SB09SS13
Sample Depth (feet bgs)	8 - 11	8 - 12	8 - 12	8.5 - 10	8 - 10	8 - 10	8 - 12	8 - 12	10 - 13
Description	Background	Sources							
TAL Metals (mg/kg)									
Aluminum	**8720**	**12500**	**17900**	**21200**	**11600**	**12300**	**18800**	**16000**	**14900**
Antimony	7.1 UJL	**0.64 JL**	**0.81 JL**	**0.69 JL**	6.8 UJL	6.9 UJL	**0.84 JL**	**1.1 JL**	**0.51 JL**
Arsenic	**2.5**	**4.3**	**1.9**	**1.3**	0.94 J	**1.3**	2.7 U	**3.4**	**3.3**
Barium	**36.2**	**49.6**	**36.8**	**64.7**	**38.3**	**56.4**	**71.2**	**36.2**	**65.5**
Calcium	**4070**	**3770**	**10200**	**2280**	**3380**	**3180**	**7820**	**10100**	**4470**
Chromium	**29.2**	**29.7**	**39.1**	**37.5**	**27.4**	**28.2**	**51.2**	**33.2**	**34.7**
Cobalt	**7.0**	**10.9**	**14.6**	5.6 J	**6.4**	**7.6**	**12.2**	**14.0**	**8.1**
Copper	**13.5**	**21.0**	**51.4**	**20.1**	**14.6**	**16.0**	**49.3**	**73.1**	**21.9**
Iron	**15000**	**18400**	**22400**	**14400**	**15800**	**16000**	**27500**	**28900**	**21200**
Lead	**1.5 JL**	**2.1 JL**	**1.6 JK**	**1.8 JL**	**1.1 JL**	**2.1 JL**	**4.1 JL**	**3.3 JL**	**3.3 JL**
Magnesium	**5460**	**5110**	**8730**	**4590**	**6130**	**4650**	**10000**	**9320**	**5380**
Manganese	**177**	**272**	**310**	**150**	**234**	**233**	**309**	**306**	**257**
Mercury	0.017 J (SQL 0.020 U)	0.009 J	0.031 J	0.037 J	0.012 J	0.025 J	**0.091**	**0.10**	**0.071**
Nickel	**43.2**	**45.9**	**42.0**	**36.9**	**42.3**	**40.8**	**42.4**	**35.8**	**35.0**
Potassium	558 J	**682**	503 J	464 J	400 J	**587**	**993**	645 J	516 J
Vanadium	**40.1**	**46.9**	**73.4**	**50.0**	**35.7**	**33.9**	**80.9**	**74.9**	**51.6**
Zinc	**28.4**	**34.6**	**46.0**	**27.1**	**26.0**	**58.3**	**59.2**	**48.6**	**33.4**
VOCs (µg/kg)									
2-Butanone	11 U	13 U	5.6 JQ	11 JQ	10 U	13 U	**29**	3.4 JQ	6.8 JQ
2-Propanone	11 U	13 U	**38**	**74**	7.1 JQ	13 U	**191**	**18**	**80**
Carbon disulfide	2.3 U	2.6 U	2.5 U	2.5 U	2.0 U	2.5 U	**2.9**	**3.6**	2.3 U
Trichloroethene	1.1 U	1.3 U	1.3 U	1.3 U	1.0 U	1.3 U	1.3 U	**43**	1.2 U
SVOCs - No SVOCs were detected above method detection limits in any sample.									
Perchlorate - Perchlorate was not detected above method detection limits in any sample.									
Hydrazines - No Hydrazines were detected above method detection limits in any sample.									
Nitrosodimethylamine - Nitrosodimethylamine was not detected above method detection limits in any sample.									

Note: Bold type indicates the sample result is above the detection limit.
Underline type indicates the sample result is significant as defined in Section 5.

Key:

bgs = Below ground surface.
CLP = Contract Laboratory Program.
EPA = United States Environmental Protection Agency.
ID = Identification.
J = The analyte was positively identified. The result is estimated because the concentration is below the Contract Required Quantitation Limits.
JL = The analyte was positively identified. The associated numerical result is an estimate that is biased low.
JQ = The analyte was positively identified. The result is estimated because the concentration is below the Contract Required Quantitation Limits.
µg/kg = Micrograms per kilogram.
mg/kg = Milligrams per kilogram.
SQL = Sample quantitation limit.
SVOCs = Semivolatile organic compounds.
TAL = Target Analyte List.
U = The analyte was not detected at or above the reported result.
VOCs = Volatile organic compounds.

7. MIGRATION/EXPOSURE PATHWAYS AND TARGETS

The following subsections describe migration pathways and potential targets within the site's range of influence (Figures 7-1 and 7-2). This section discusses the groundwater migration pathway (subsection 7.1) and the surface water migration pathway (subsection 7.2). The soil exposure and air migration pathways have not been included in this report to conserve funding resources and to concentrate and expand efforts on the pathways of greatest concern (i.e., the groundwater and surface water migration pathways).

7.1 GROUNDWATER MIGRATION PATHWAY

Nike Site #92 lies within the Puget Trough section of the Pacific Border physiographic province. The Kitsap Peninsula, on which the site lies, consists of glacially modified highlands and rolling plains separated by marine embayments and river valleys. The highlands and plains are covered by stratified and unstratified glacial deposits (i.e., glacial till, stratified glacial drift). Groundwater in the region comes predominantly from alluvium and stratified glacial deposits. (Law 1988)

The site is contained in the northern uplands of the Kitsap Peninsula. The Kitsap Peninsula, bordered by Puget Sound on the east and the Hood Canal on the west, is underlain by as much as 1,500 feet of Quaternary sediments consisting primarily of varying thicknesses of Pleistocene-aged fine-grained silts and clays alternating with coarser sands and gravels. Numerous glacial cycles occurred throughout the Pleistocene causing the accumulation of the interstratified fine- and coarse-grained material. The silts and clays were deposited in shallow lakes and swamps during interglacial periods. The sands and gravels are thought to have been deposited as both glacial drift and on the margins of mountain valleys. (Law 1988)

The primary water bearing unit in the Pleistocene strata is the Colvos Sand. This formation yields moderately large quantities of water for domestic supply. Above the Colvos Sand is a sequence of glacial outwash and till deposits which are relatively impermeable. The glacial material contains some discontinuous zones of water bearing sands and gravel. (Law 1988)

The North Kitsap Public Utility Department describes two aquifers as present in the area of the site. The direction of flow in both aquifers is generally to the east. The shallow aquifer is generally referred to as the Vashon Advanced Outwash Sand or Colvos Sand. This aquifer discharges at locations

above sea level. The second aquifer is a deeper aquifer generally referred to as the Below Sea Level Aquifer, and as the name implies, is present at depths below sea level. The aquifers are hydrologicially interconnected. However, it appears that the shallow perched groundwater zone present in the area of the site is not in hydrologic communication with the deeper aquifers. (Hunter 2004, Sebren 2004)

During the PA/SI (April 2004) the static groundwater level at the site was observed to be between 3.4 and 15.29 feet bgs, with topographically higher locations having deeper static water levels. In November 2003, groundwater at the site was encountered between 11 and 25 feet bgs (Kane 2004). In June 1987, groundwater was encountered between 17 and 28 feet bgs. Shallow groundwater at the site appears to be controlled primarily by the occurrence and extent of coarse-grained material and to a lesser degree by surface topography. The direction of groundwater flow in this shallow zone is not known, but may be toward the northwest following surface topography. The variations observed in water table elevations may be a possible reflection of perched water table conditions. The layers of coarse-grained drift, which appear to be the water bearing stratum, may not be interconnected. Groundwater may be present only in discontinuous pods of glacial drift or in perched zones. (Law 1988)

The target distance limit (TDL) for the groundwater migration pathway is a 4-mile radius that extends from the sources at a site. Figure 1-4 depicts the groundwater TDL for Nike Site #92. No drinking water wells currently are present at the site. Approximately 1,000 domestic drinking water wells are present within the 4-mile TDL (WSDWR various dates). It is estimated that these wells serve 2,680 people based on the average number of persons per household for Kitsap County of 2.68 people (USDC 2001). The nearest domestic drinking water well is located between 0 and 0.25 mile from the nearest area of potential concern (WSDWR various dates).

The North Kitsap Public Utility District operates two water systems within 4 miles of the site: the Kingston Water System and the Indianola Water System. The Kingston Water System includes seven municipal wells (Wells 2 through 7 and the Ritter Road Well), with all but one within 2 miles of the site (Hunter 2004b). Kingston municipal Wells 2 through 7 are located northeast or southeast of the site; the Ritter Road Well is located west of the site (WSDWR various dates). Wells 2 and 3 have not been used to supply drinking water in the last year due to the presence of high manganese concentrations, however, they have been used in the past to supply drinking water on an emergency basis (Hunter 2004b). Manganese in south and north Kitsap County occurs naturally at high concentrations. Several municipal wells in these areas treat their water for manganese prior to distribution including the Keyport, Washington water system, the Vinland water system near Lofall, Washington, and the Bainbridge Island water system in Bainbridge, Washington. The North Kitsap Public Utility District is considering the possibility of treating Kingston Wells 2 and 3 for manganese and reopening them (Hunter 2004c). Water

rights on Well 7 have not yet been provided by the State of Washington, however, it also is used to supply drinking water on an emergency basis (Hunter 2004b).

Wells 2, 3, and 4 all draw water from the same shallower aquifer (i.e., Vashon Advanced Outwash Sand or Colvos Sand; Hunter 2004, Sebren 2004). Wells 5 and 6 both draw from the same deep aquifer (i.e., Below Sea Level Aquifer; Hunter 2004, Sebren 2004). Currently, the aquifer Well 7 draws from is not known, but it may be the deep, Below Sea Level Aquifer (Hunter 2004). The Ritter Road Well, located west of the site, draws from a different aquifer than the other six wells (Hunter 2004). This aquifer flows west rather than east (Hunter 2004). Water from the municipal wells is blended in a reservoir prior to distribution (Hunter 2004). No contamination has been detected in the municipal wells during routine testing for metals and VOCs (Hunter 2004). The wells serve 3,896 equivalent housing units (Hunter 2004). Based on the average number of persons per household for Kitsap County of 2.68 people, it is estimated that these wells supply drinking water to 10,441 people (USDC 2001).

The Indianola Water System, also operated by the North Kitsap Public Utility District, includes four wells (Wells 1A, 3, 4, and 6), all of which are located between 3 and 4 miles south of the site. Well 4 is no longer in use. Well 3 is a standby well that is only used when Well 1A is off-line for servicing. Wells in this system are in a different aquifer system from the one beneath Nike Site #92. Water from the wells is blended in distribution lines as it is pumped to residences. No contamination has been detected in these wells during routine testing. The wells serve 640 equivalent housing units (Hunter 2004a). Based on the average number of persons per household for Kitsap County of 2.68 people, it is estimated that these wells supply drinking water to 1,715 people (USDC 2001). Municipal well depths and pumping capacities for wells operated by the North Kitsap Public Utility District are provided in Table 7-1.

Finally, five community wells are present within 4 miles of the site. Telephone numbers for the operators of these systems could not be located. For this reason, it will be assumed that each well serves 2.68 people (the average number of persons per household in Kitsap County).

The nearest municipal drinking water well to the site is Kingston Water System Well 4 located approximately 0.75 mile northeast of the site (WSDWR various dates). Populations using groundwater for drinking water within the site's 4-mile groundwater TDL by distance rings are summarized in Table 7-2.

Groundwater is used for irrigation (actual acreage irrigated is not known; WSDWR various dates). Groundwater is not used for commercial food preparation, as a supply for commercial aquaculture, or as a supply for a major or designated water recreation area (WSDWR various dates). The site is in a wellhead protection area (Hunter 2004).

Sample locations and analytical results of samples collected from groundwater are presented in the following subsections.

7.1.1 Sample Locations

Groundwater samples were collected from two onsite monitoring wells (MW02 and MW03) and from six drinking water wells (DW02 through DW07). Figure 3-2 depicts the drinking water well locations and Table 7-3 provides well depths and screened intervals for both monitoring and drinking water wells, including background wells. MW02 was installed immediately south of the 3-foot by 8-foot open concrete vault near the septic drain field. This well was co-located with subsurface soil sample SB02SS11. MW03 was installed immediately south of the Former Warheading Building. This well was co-located with subsurface soil sample SB03SS12. Since water recovery in this well was poor, three attempts were made to offset this location and install a replacement well. However, a cemented layer of silty soil at approximately 11 feet bgs, prevented successful installation of a new well. For this reason, the existing well was used despite poor water recovery. This well was sampled on three consecutive days to try to retrieve enough water volume for analyses. Samples from each day were given individual sample numbers (MW03, MW03A, and MW03B). On the first day, April 30, 2004, enough water was recovered for VOCs and SVOCs analyses (MW03). On May 1, 2004, enough water was recovered for perchlorate analysis (MW03A). On the final day of sampling, May 2, 2004, enough water was recovered for nitrosodimethylamine analysis (MW03B). A decision was made not to return a fourth day to try to recover enough water for TAL metals or hydrazines analysis. This decision was made since the well water was turbid and likely contained suspended soil particles that would elevate TAL metals results and since hydrazines had not previously been detected in this area during recent sampling efforts conducted by the NKSD.

Drinking water sample DW05 was collected from a downgradient domestic well within 0.25 mile of the site. Drinking water samples DW02, DW04, DW06, and DW07 were collected from downgradient domestic wells between 0.25 and 0.5 mile of the site. Drinking water sample DW03 was collected from NKPUD municipal Well #4 located approximately 0.75 mile downgradient of the site. The drinking water wells were resampled on May 5, 2004 to collect new aliquots for hydrazine analysis since holding times on the original set of aliquots had been exceeded by the time they arrived at the laboratory. Samples from this day were given new sample numbers (i.e., DW01A through DW07A). Table 7-3 provides drinking water well information including the depth of each well, each well's screened interval, and the number of residents using the well.

7.1.2 Sample Results

Groundwater sample results from monitoring wells are presented in Table 7-4. Sample results from drinking water wells are presented in Table 7-5. Elevated concentrations of 2-butanone and 2-propanone were detected in monitoring well MW03 located near the Former Warheading Building. No VOCs were detected in monitoring well MW02 located near the septic drainfield. SVOCs, TAL metals, perchlorate, hydrazines, and nitrosodimethylamine were not detected at elevated concentrations in the two monitoring wells.

No analytes were detected at elevated concentrations in drinking water well samples DW02 and DW03. DW04 and DW06 contained elevated concentrations of zinc, drinking water well sample DW05 contained an elevated concentration of manganese, and drinking water well sample DW07 contained an elevated concentration of trichloromethane. The well user of DW07 occasionally treats this well with chlorine. It is likely the elevated concentration of trichloromethane (also known as chloroform) is a result of periodic chlorine treatments. SVOCs, perchlorate, hydrazines, and nitrosodimethylamine were not detected in any of the drinking water wells at elevated concentrations.

Water from DW04 was orange or rust-colored as it emerged from the backyard spigot, the nearest spigot to the wellhead. This spigot had a steel water pipe. It is likely this coloration was due to rust in the water line since tap water from inside the residence was clear and, according to the well owner, the backyard spigot is used infrequently. Water from the well was allowed to purge for 40 minutes prior to sampling. Although, the turbidity did improve, the water did not run clear. Further, this sample contained a higher than normal concentration of iron indicating the presence of rust in the sample. It is expected that the elevated concentration of zinc in the water sample from this well also is an artifact of rust in the water line, rather than an indication of ambient groundwater conditions at the well.

EPA National Primary Drinking Water Standards, also known as Maximum Contaminant Levels (MCLs), for the three analytes detected at elevated concentrations in drinking water wells (manganese, zinc, and trichloromethane) do not exist (EPA 2002b). The EPA has established National Secondary Drinking Water Regulations (NSDWRs or secondary standards) for manganese and zinc. These secondary standards are *non-enforceable* guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. The elevated concentration of manganese (DW05) exceeded the secondary standard of 50 µg/L. The elevated concentrations of zinc (DW04 and DW06) detected did not exceed the secondary standard of 5,000 µg/L.

The sample aliquot for hydrazines analysis from DW06 broke during shipment to the laboratory. A drinking water well sample was collected from the residence immediately to the east (DW04). This

well has a similar depth to DW06 and it did not contain detectable concentrations of hydrazines. For this reason, and because no hydrazines were detected in any samples collected as a part of this project, it is unlikely that hydrazines would be present in this well.

7.2 SURFACE WATER MIGRATION PATHWAY

The surface water migration pathway TDL begins at the probable point of entry (PPE) of surface water runoff from a site to the nearest surface waterbody and extends downstream for 15 miles.

The two-year, 24-hour rainfall event for the site is 2.5 inches (NOAA 1973). The average annual net precipitation is 51.63 as measured at Bremerton, Washington, located approximately 12 miles south of the site (WRCC 2004). The upgradient drainage area of the site is estimated from a topographic map to be 20 acres (USGS 1973).

Land at the site slopes gently northwest. Northern portions of the site drain approximately 100 feet to the wetland west of the missile magazines (Figure 7-2). Southern site features drain to a forested area and then likely infiltrate the ground, although, some runoff collects in the small marshy pond located near the forest edge. The Northwest Wetland has an outlet located on its west side which leads to Carpenter Lake. This outlet only flows seasonally (NKSD 2003). Since the site is not in an arid climate (i.e., having less than 20 inches on average of net annual precipitation) this outlet does not qualify as a surface waterbody under the CERCLA site assessment program. Both the Northwest Wetland and the small marshy pond are considered isolated waterbodies. Therefore, the TDL for Nike Site #92 does not extend for 15-miles, but rather includes only the Northwest Wetland.

Soils at the site are classified as Poulsbo gravelly sandy loam. Typically, the surface of this soil is covered by a 2-inch mat of undecomposed and partially decomposed needles, leaves, and wood fragments. The subsurface layer is dark grayish brown gravelly sandy loam 2 inches thick. The subsoil is dark brown and dark yellowish brown gravelly sandy loam 22 inches thick. The substratum is a weakly-silica-cemented hardpan about 4 inches thick over very compact, gravely sandy loam glacial till. Depth to the hardpan ranges from 20 to 40 inches. Permeability of this Poulsbo soil is moderately rapid above the hardpan and very slow through the pan. Runoff is slow, and the hazard of water erosion is slight. (USDA 1980)

Water in the Northwest Wetland is not used for any purpose (i.e., drinking water, irrigation, watering of livestock). The wetland is not known to be used for fishing. No federal- or state-listed endangered or threatened species are known to be present in the wetland (WSDF&W 2003). The wetland has been identified as a palustrine forested wetland (NKSD 2003). The wetland perimeter measures approximately 0.23 linear mile (NKSD 2003).

7.2.1 Sample Locations

Sediment samples were collected from the on-site Northwest Wetland, a palustrine-forested wetland, and from the marshy pond. Sediment samples SD02 and SD03 were collected near the discharge pipes leading from the missile magazine area to the wetland. Sediment sample SD04 was collected from the west side of the Northwest Wetland near the outflow channel for the wetland. Sediment sample SD05 was collected from the on-site marshy pond near the location where adjacent property owner's had once observed a white residue. At the time of sampling, decaying leaves along the perimeter of the pond appeared to be pale. In a more advanced state of decay, this material may appear to be white and be less distinguishable as vegetative matter.

7.2.2 Sample Results

Sediment sample results are presented in Table 7-6. Sediment samples collected from the Northwest wetland (SD02, SD03, and SD04) contained elevated concentrations of up to five TAL metals including barium, cadmium, lead, manganese, and zinc. Sediment samples from this wetland also contained elevated concentrations of up to four VOCs including 2-butanone, 1-methylethylbenzene, ethylbenzene, and toluene. The sediment sample from the marshy pond (SD05) contained elevated concentrations of the TAL metals barium and zinc; and the VOCs methylene chloride and toluene. The concentrations of methylene chloride in this sample is an estimated concentration that was determined to be higher than it's actual concentration (see the Data Validation Memorandum in Appendix D for additional information concerning this estimated result). SVOCs, perchlorate, hydrazines, and nitrosodimethylamine were not detected in any sediment sample.

Table 7-1

WELL INFORMATION
NIKE SITE #92
KINGSTON, WASHINGTON

Identification	Well Depth (feet bgs)	Screen Depth (feet bgs[a])	Pumping Capacity (gpm)
Kingston Well 2	345	NA	200
Kingston Well 3	550	475 to 485	120
Kingston Well 4	214	192 to 202	150
Kingston Well 5	806	745 to 755 and 765 to 775	400
Kingston Well 6	807	742 to 752, 762 to 782, and 782 to 807	600
Kingston Well 7	600	519 to 555 and 575 to 595	750
Kingston Ritter Road Well	334	265 to 285 and 302 to 322	300
Indianola Well 1A	415	271 to 302, 356 to 371, and 386 to 396	200
Indianola Well 3	415	271 to 302, 356 to 371, and 386 to 396	200
Indianola Well 6	348	308 to 318 and 318 to 338	40

Sources: Hunter 2004a: Hunter 2004b; WSDWR various dates.

[a] Screened intervals rounded to nearest integer.

Key:

bgs = Below ground surface.
gpm = Gallons per minute.
NA = Not available.

Table 7-2

GROUNDWATER DRINKING WATER POPULATION WITHIN A 4-MILE RADIUS
NIKE SITE #92
KINGSTON, WASHINGTON

Distance Ring (miles)	Well Identification[a]	Well Population[b]	Total Population Per Distance Ring
0 to 0.25	Domestic (2)	5.36	5.36
0.25 to 0.5	Domestic (15)	40.2	40.2
0.5 to 1	Municipal (3) Domestic (73)	7,830.75 195.64	8,026.39
1 to 2	Domestic (245)	656.6	656.6
2 to 3	Municipal (1) Community (3) Domestic (322)	2,610.25 8.04 862.96	3,481.25
3 to 4	Municipal (2) Community (2) Domestic (343)	1,715 5.36 919.24	2,639.6
Total			14,849.4

Sources: USDC 2001; WSDWR various dates.

[a] Standby municipal wells are not included in this table.
[b] Domestic well population was estimated based on the average number of persons per household for Kitsap County of 2.68 people.

Table 7-3

SAMPLED WELL INFORMATION
NIKE SITE #92
KINGSTON, WASHINGTON

Sample Identification	Well Location	Well Depth (feet bgs)	Screen Depth (feet bgs[a])	Number of Residents Using Well
MW01	9200 block of NE West Kingston Rd.	20	10 to 20	NA
MW02	Nike Site #92, near septic drain field	20	10 to 20	NA
MW03	Nike Site #92, near Former Warheading Building	20	15 to 20	NA
DW01	9200 block of NE West Kingston Rd.	112	107 to 112	3
DW02	26300 block of Barber Cut-off Rd. NE	349	344 to 349	3
DW03	NKPUD Well #4	214	192 to 202	2,610
DW04	26100 block of NE Barrett Rd.	74	No screen	2
DW05	26000 block of Barber Cut-off Rd. NE	< 100	Not known	2
DW06	26200 block of NE Barrett Rd.	69	66 to 69	5
DW07	25800 block of Sowsear Lane NE	< 100	Not known	3

Sources: WSDWR various dates.

[a] Screened intervals rounded to nearest integer.

Key:

bgs = Below ground surface.
NA = Not applicable.
NE = northeast
NKPUD = North Kitsap Public Utility District.
Rd = Road.

Table 7-4

MONITORING WELL SAMPLES ANALYTICAL RESULTS SUMMARY
NIKE SITE #92 PRELIMINARY ASSESSMENT/SITE INSPECTION
KINGSTON, WASHINGTON

EPA Sample ID	04184022	04184024	04184027
CLP Organic ID	J2C34	J2C39	J2C41
CLP Inorganic ID	MJ2C34	MJ2C39	MJ241
Station Location	MW01	MW02	MW03
Description	Background		
TAL Metels (µg/L)			
Aluminum	**24800**	**11700**	NA
Calcium	**18500**	**12200**	NA
Chromium	**104**	**32.1**	NA
Copper	**46.1**	15.8 J	NA
Iron	**36500**	**13600**	NA
Magnesium	**21200**	**8330**	NA
Manganese	**488**	**271**	NA
Nickel	**107**	**44.2**	NA
Potassium	**3190 JK**	**1370 JK**	NA
Sodium	**9860**	**6800**	NA
Vanadium	**86.9**	35.3 J	NA
Zinc	**101**	36.3 J	NA
VOCs (µg/L)			
2-Butanone	2.5 U	2.5 U	**4.4**
2-Propanone	2.2 UJK	1.8 UJK	**21 JH**
SVOCs - No SVOCs were detected above method detection limits in any sample.			
Perchlorate - Perchlorate was not detected above method detection limits in any sample.			
Hydrazines - No Hydrazines were detected above method detection limits in any sample.			
Nitrosodimethylamine - Nitrosodimethylamine was not detected above method detection limits in any sample.			

Note: Bold type indicates the sample result is above the detection limit.

Underline type indicates the sample result is elevated as defined in Section 5.

Key:

CLP = Contract Laboratory Program.

EPA = United States Environmental Protection Agency.

ID = Identification.

J = The analyte was positively identified. The result is estimated because the concentration is below the Contract Required Quantitation Limits.

JH = The analyte was positively identified. The associated numerical result is an estimate that is biased high.

JK = The analyte was positively identified. The associated numerical result is an estimate with an unknown bias.

NA = Not analyzed.

SVOCs = Semivolatile organic compounds.

µg/L = Micrograms per liter.

U = The analyte was not detected at or above the reported result.

VOCs = Volatile organic compounds.

Table 7-5

DRINKING WATER SAMPLES ANALYTICAL RESULTS SUMMARY
NIKE SITE #92 PRELIMINARY ASSESSMENT/SITE INSPECTION
KINGSTON, WASHINGTON

EPA Sample ID	**04184004**	**04184005**	**04184018**	**04184019**	**04184021**	**04184023**	**04184025**
CLP Organic ID	**J2C21**	**J2C22**	**J2C33**	**J2C35**	**J2C37**	**J2C38**	**J2C40**
CLP Inorganic ID	**MJ2C21**	**MJ2C22**	**MJ2C33**	**MJ2C35**	**MJ2C37**	**MJ2C38**	**MJ2C40**
Station Location	**DW01**	**DW02**	**DW03**	**DW04**	**DW05**	**DW06**	**DW07**
Description	**Background**						
TAL Metels (µg/L)							
Calcium	**16400**	**14400**	**27700**	**24000**	**30600**	**20500**	**18500**
Iron	55.6 J	**178**	**247**	**3240**	**402**	100 U	**280**
Magnesium	**6550**	3600 J	**20700**	**18700**	**19000**	**18300**	**9000**
Manganese	**30.1**	**32.7**	8.8 J	**22**	**<u>924</u>**	0.47 J	**67.4**
Potassium	**3100 JK**	**3320 JK**	**1570 JK**	**1130 JK**	**3780 JK**	**1020 JK**	**8550 JK**
Sodium	**8570**	**46800**	**8830**	**9920**	**9490**	**9790**	**33000**
Zinc	2.4 J (SQL = 60 U)	28.3 J	39.9 J	**<u>550</u>**	29.6 J	**<u>88.9</u>**	10.5 J
VOCs (µg/L)							
Trichloromethane	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	**<u>1.6</u>**
SVOCs - No SVOCs were detected above method detection limits in any sample.							
Perchlorate - Perchlorate was not detected above method detection limits in any sample.							
Hydrazines - No Hydrazines were detected above method detection limits in any sample.							
Nitrosodimethylamine - Nitrosodimethylamine was not detected above method detection limits in any sample.							

Note: Bold type indicates the sample result is above the detection limit.
Underline type indicates the sample result is elevated as defined in Section 5.

Key:

CLP = Contract Laboratory Program.
EPA = United States Environmental Protection Agency.
ID = Identification.
J = The analyte was positively identified. The result is estimated because the concentration is below the Contract Required Quantitation Limits.
JK = The analyte was positively identified. The associated numerical result is an estimate with an unknown bias.
µg/L = Micrograms per liter.
SQL = Sample quantitation limit.
SVOCs = Semivolatile organic compounds.
TAL = Target Analyte List.
U = The analyte was not detected at or above the reported result.
VOCs = Volatile organic compounds.

Table 7-6

WETLAND SAMPLES ANALYTICAL RESULTS SUMMARY
NIKE SITE #92 PRELIMINARY ASSESSMENT/SITE INSPECTION
KINGSTON, WASHINGTON

EPA Sample ID	04184020	04184000	04184001	04184002	04184003
CLP Organic ID	J2C36	J2C17	J2C18	J2C19	J2C20
CLP Inorganic ID	MJ2C36	MJ2C17	MJ2C18	MJ2C19	MJ2C20
Station Location	SD01	SD02	SD03	SD04	SD05
Sample Depth (inches bgs)	0 - 6	0 - 6	0 - 6	0 - 6	0 - 6
Description	Background				
TAL Metels (mg/kg)					
Aluminum	**20700**	**17100**	**16700**	**13100**	**10400**
Antimony	**33.7 JL**	**1.4 JL**	**1.6 JL**	32.5 UJL	**2.0 JL**
Arsenic	**6.8**	**18.1**	**11.2**	4.9 J	**10.4**
Barium	51.4 J (SQL = 112.3 U)	**149**	**94.2**	**195**	**207**
Cadmium	2.8 U	**6.4**	**2.7**	0.64 J	1.3 J
Calcium	**5760**	**3790**	**7630**	**12000**	**5770**
Chromium	**32.5**	**45.3**	**37.0**	**12.7**	**17.6**
Cobalt	3.7 J (SQL = 28.1 U)	**12.6**	5.5 J	2.3 J	3.3 J
Copper	**37.6**	**34.9**	**37.0**	**29.5**	**36.5**
Iron	**12100**	**31600**	**16800**	**8250**	**13500**
Lead	**37.5 JL**	**147 JL**	**72.1 JL**	**38.5 JL**	**58.6 JL**
Magnesium	**5030**	**4370**	**4430**	1630 J	1450 J
Manganese	**50.4**	**1060**	**179**	**218**	**148**
Mercury	**0.26 JK**	**0.51**	**0.13**	**0.2 JK**	**0.24 JK**
Nickel	**31.1**	**39.8**	**36.4**	14.0 J	**20.2**
Vanadium	**36.6**	**55.6**	**50.3**	13 J	**25.4**
Zinc	30.4 J (SQL = 33.7 U)	**1130**	**133**	**68.3**	**512**
VOCs (µg/kg)					
2-Butanone	33 JQ (SQL = 37 U)	**45**	**47**	**50**	39 JQ
2-Propanone	**120**	**180 JL**	**150 JL**	**250**	**130**
Benzene, (1-methylethyl)-	3.7 U	4.1 U	**11 JH**	2.1 U	9.7 U
Ethylbenzene	3.7 U	**16**	**13**	2.1 U	9.7 U
Methylene Chloride	7.3 U	2.1 U	2.1 U	4.2 U	**160 JH**
Toluene	3.7 U	**914**	**271**	**26 JH**	**480**
SVOCs - No SVOCs were detected above method detection limits in any sample.					
Perchlorate - Perchlorate was not detected above method detection limits in any sample.					
Hydrazines - No Hydrazines were detected above method detection limits in any sample.					
Nitrosodimethylamine - Nitrosodimethylamine was not detected above method detection limits in any sample.					

Note: Bold type indicates the sample result is above the detection limit.
Underline type indicates the sample result is elevated as defined in Section 5.

Key:

bgs = below ground surface.
CLP = Contract Laboratory Program.
EPA = United States Environmental Protection Agency.
ID = Identification.
J = The analyte was positively identified. The result is estimated because the concentration is below the Contract Required Quantitation Limits.
JH = The analyte was positively identified. The associated numerical result is an estimate that is biased high.
JL = The analyte was positively identified. The associated numerical result is an estimate that is biased low.
JK = The analyte was positively identified. The associated numerical result is an estimate with an unknown bias.
JQ = The analyte was positively identified. The result is estimated because the concentration is below the Contract Required Quantitation Limits.
µg/kg = Micrograms per kilogram.
mg/kg = Milligrams per kilogram.
SQL = Sample quantitation limit.
SVOCs = Semivolatile organic compounds.
TAL = Target Analyte List.
U = The analyte was not detected at or above the reported result.
VOCs = Volatile organic compounds.

8. SUMMARY AND CONCLUSIONS

In late April and early May 2004, the START-2 conducted PA/SI sampling activities at the Nike Site #92 facility located in Kingston, Washington. The site is a former DoD missile launch facility located on property currently owned by the NKSD. The site operated continuously from approximately 1954 to 1975, first as an Ajax missile launch facility and subsequently as a Hercules missile launch facility. The missiles used rocket fuels that contained hazardous substances including UDMH, inhibited red fuming nitric acid, aniline, furfuryl alcohol, ethylene oxide, and perchlorate. Information relating to the types of hazardous substance used operationally at the site and their waste handling and disposal are not available. Ancillary information on Nike sites in general indicates that petroleum products were used in the maintenance of base vehicles and missiles, and in supplying fuel for generators and heaters. Cleaning solvents were used in vehicle and missile maintenance. In general, the types of solvents used at Nike sites were Stoddard-type solvents (petroleum distillate), carbon tetrachloride, trichloroethane(s), perchloroethene, and trichloroethene. Painting of missile components involved the use of paints containing heavy metals.

Many structures that were present during the operational years at the site have been demolished or sealed, however, a few features still remain including the Missile Assembly and Test Building, the Fallout Shelter, the Barracks Building (currently the location of the Spectrum Community School), and the Septic System (no longer in use). The NKSD bus maintenance facility is located on the property. The NKSD has proposed a plan to build a new high school on the property with parking areas, roads, and athletic fields positioned over former Nike Site #92 features.

The PA/SI involved the collection of samples from potential hazardous substance sources on site. A total of 28 samples were collected for the PA/SI, including background and QA samples. Samples were collected from subsurface soil, sediments, and groundwater. Samples were analyzed by the EPA Manchester Laboratory, a CLP laboratory, and by a commercial laboratory under subcontract to the START-2.

8.1 SOURCES

A total of six potential source areas at the Nike Site #92 were sampled including the Septic System, the Former POL Storage Area, the Former Auto Shop, the Former Warheading Building, the Missile Assembly and Test Building, and the Former Acid Neutralizing Pit. With the exception of 2-propanone, hazardous substances were not detected at significant concentrations in samples collected at the Septic System, the Former POL Storage Area, and the Former Auto Shop.

Subsurface soil samples collected from the area of the Former Warheading Building contained significant concentrations of copper, mercury, 2-butanone, 2-propanone, and carbon disulfide. Shallow groundwater at this source also contained 2-butanone and 2-propanone at elevated concentrations.

Subsurface soil samples collected from the Missile Assembly and Test Building contained significant concentrations of copper, mercury, 2-propanone, carbon disulfide, and trichloroethene.

Subsurface soil samples collected from the Former Acid Neutralizing Pit contained significant concentrations of mercury and 2-propanone.

Table 8-1 provides residential soil EPA Region 9 Preliminary Remedial Goals (PRGs) for those analytes that were detected at elevated concentrations in soil (and sediment) samples collected as a part of the PA/SI. PRGs are risk-based concentrations that are intended to assist in initial screening-level evaluations. They are generic concentrations that have been calculated without site specific information and are viewed by EPA as guidelines. PRGs are not *de facto* cleanup standards and should not be applied as such. Generally, cleanup values would be significantly higher than the PRGs. The significant concentrations of hazardous substances detected in on-site sources did not exceed residential soil PRGs.

8.2 TARGETS

The site currently contains the Spectrum Community School and the NKSD bus maintenance facility located to the east and northeast of previous Nike Site #92 features. Areas to the north and west of site related features are undeveloped and currently contain forest and a wetland. Residences are located south of the site.

Groundwater is used extensively in the area of the site for drinking water with over 1,000 wells present within 4 miles. Shallow groundwater at the site contained elevated concentrations with respect to background concentrations of the VOCs 2-butanone and 2-propanone. Nearby drinking water wells did not similarly contain these compounds. Four drinking water wells did contain an elevated concentration with respect to background concentrations of one analyte each: manganese in DW05, zinc in DW04 and DW06, and trichloromethane in DW07. These analytes were not detected in potential source samples or

in on-site groundwater samples at significant/elevated concentrations with respect to background concentrations.

Table 8-2 provides MCLs, NSDWRs, and tap water PRGs for analytes detected at elevated concentrations in groundwater samples collected as a part of the PA/SI. Manganese was the only analyte in a groundwater sample to exceed a standard, exceeding both the non-enforceable NSDWR and the non-enforceable tap water PRGs. Again, a source of manganese was not present at the site. Manganese in groundwater is known to be naturally high in the area of the site. As previously discussed in subsection 7.1, two municipal wells have been closed due to poor water quality caused by naturally high manganese concentrations.

The Northwest Wetland also contained elevated concentrations with respect to background concentrations of the TAL metals barium, cadmium, cobalt, lead; and the VOCs 2-butanone, 1-methylethylbenzene, ethylbenzene, and toluene. Of these analytes, only 2-butanone was similarly detected in a potential source at the site (i.e., the Former Warheading Building). At this source, 2-butanone was detected in both subsurface soils and in shallow groundwater. It is possible that shallow groundwater near the Former Warheading Building flows toward the Northwest Wetland based on observed site topography and available groundwater information.

EPA PRGs specific to sediments do not exist, but comparing sediment results to residential soil PRGs can give an indication of relative risk. Table 8-1 provides residential soil PRGs for those analytes that were detected at elevated concentrations in sediment (and subsurface soil) samples collected as a part of the PA/SI. The elevated concentrations of hazardous substances detected in the Northwest Wetland, including those for 2-butanone which was detected in subsurface soil and groundwater at the site, did not exceed residential soil PRGs.

8.3 CONCLUSIONS

Overall, significant concentrations of analytes detected in source samples collected during the PA/SI were limited to TAL metals and VOCs. SVOCs (which were analyzed using a modified method to achieve lower than routine detection limits), perchlorate, hydrazines, and nitrosodimethylamine were not detected in any of the samples above method detection limits. The TAL metals detected at significant concentrations included copper and mercury. These heavy metals may be associated with paints and/or metal pipes used at the site. The VOCs detected at significant concentrations included 2-butanone (also known as methylene ethyl ketone), 2-propanone (also known as acetone), carbon disulfide, and trichloroethene. These contaminants are generally solvent-related compounds which could have been used at the site.

All significant/elevated concentrations of hazardous substances detected in PA/SI subsurface soil samples and sediment samples are below residential soil PRGs. Groundwater results indicated the presence of manganese at a concentration above a non-enforceable regulatory standard (i.e., the NSDWR) and above the non-enforceable tap water PRG in one domestic well. However, a source of manganese contamination was not detected at the site. Manganese is known to occur at naturally high levels in groundwater in the area. All other elevated concentrations of analytes in groundwater samples were below MCLs, NSDWRs, and tap water PRGs.

The VOC methylene chloride has been detected in samples collected during two previous investigations at the site. A determination regarding whether the presence of this compound was a result of past site activities or an artifact of laboratory contamination could not be decisively made based on prior sample results. During the PA/SI, extra care and additional measures were taken by the field team and the analytical laboratory (i.e., the EPA Region 10 Manchester Laboratory) to guard against introduction of this compound during sample handling and laboratory analyses. PA/SI sample results indicate that methylene chloride was detected in only one sample at 160 micrograms per kilogram (µg/kg). This sample was from the on-site marshy pond. Again, the reported concentration was well below the EPA residential soil PRG of 9,100 µg/kg. Overall, it appears that methylene chloride is not a concern at the site based on PA/SI sample results.

Table 8-1

COMPARISON OF MAXIMUM SOIL AND SEDIMENT RESULTS TO PRGs
NIKE SITE #92 PRELIMINARY ASSESSMENT/SITE INSPECTION
KINGSTON, WASHINGTON

Analyte	Maximum Elevated Concentration of PA/SI Results	Residential Soil PRGs[a]
TAL Metals (mg/kg)		
Barium	207	5,400
Cadmium	6.4	37
Copper	73.1	3,100
Lead	147 JL	400
Manganese	1060	1,800
Mercury	0.1	23
Zinc	1130	23,000
VOCs (ug/kg)		
Benzene, (1-methylethyl)- (cumene)	11 JH	570,000
2-Butanone (methyl ethyl ketone)	50	7,300,000
Carbon disulfide	3.6	360,000
Ethylbenzene	16	8,900
Methylene chloride	160 JH	9,100
2-Propanone (acetone)	191	1,600,000
Trichloroethene	43	53
Toluene	914	520,000

[a] - EPA Region 9 Preliminary Remedial Goals which are risk-based concentrations intended to assist in initial screening-level evaluations of environmental measurements.

Key:

µg/kg = Micrograms per kilogram.
mg/kg = Milligrams per kilogram.
PA/SI = Preliminary assessment/site inspection.
PRG = Preliminary Remedial Goal.
TAL = Target Analyte List.
VOCs = Volatile organic compounds.

Table 8-2

COMPARISON OF MAXIMUM GROUNDWATER RESULTS TO MCLs AND PRGs
NIKE SITE #92 PRELIMINARY ASSESSMENT/SITE INSPECTION
KINGSTON, WASHINGTON

Analyte	Maximum Elevated Concentration of PA/SI Results	MCLs[a]	NSDWR[b]	Tap Water PRGs[c]
TAL Metals (ug/L)				
Manganese	924	NA	50	880
Zinc	550	NA	5,000	11,000
VOCs (ug/L)				
2-Butanone (methyl ethyl ketone)	4.4	NA	NA	1,900
2-Propanone (acetone)	21 JH	NA	NA	610
Trichloromethane (chloroform)	1.6	NA	NA	6.2

[a] - EPA National Primary Drinking Water Maximum Contaminant Levels which are legally enforceable standards that apply to public water systems.

[b] - EPA National Secondary Drinking Water Regulations which are non-enforceable guidelines regulating contaminants that may cause cosmetic or aesthetic effects.

[c] - EPA Region 9 Preliminary Remedial Goals which are risk-based concentrations intended to assist in initial screening-level evaluations of environmental measurements.

Key:

MCL = Maximum Contaminant Level.
µg/L = Micrograms per liter.
NSDWR = National Secondary Drinking Water Regulation.
PA/SI = Preliminary assessment/site inspection.
PRG = Preliminary Remedial Goal.
TAL = Target Analyte List.
VOCs = Volatile organic compounds.

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